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Identifying and addressing barriers to renewable energy development in Pakistan

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Abstract

To ensure a sustainable energy future for Pakistan, it is necessary that the energy sector be accorded a high priority. Pakistan remains predominantly reliant on fossil fuels as its primary source of energy. Efforts to reduce reliance on fossil fuels through increasing the share of renewable energy in the energy supply systems have met with little success so far. The barriers to development of renewable energy can be broadly classified as policy and regulatory barriers, institutional barriers, fiscal and financial barriers, market-related barriers, technological barriers and information and social barriers. In this article, an effort has been made to identify the barriers that limit the use of renewable energy technologies in general and with specific reference to Pakistan, and outline the measures to address these barriers.

Keywords: Renewable energy; Barriers; Pakistan

Contents

1. Introduction

To ensure a sustainable energy future for Pakistan, it is necessary that the energy sector be accorded a high level of importance by government and various development partners and donor agencies. Invariably a sustainable energy sector can be achieved through the development and implementation of long-term energy policies and guidelines, better planning and strategies, development and utilization of indigenous resources and the promotion of commercially proven renewable energy technologies. The development of renewable energy resources contributes to economic growth, improves living standards of

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communities in remote areas, and reduces greenhouse gas emissions and other air pollutants. Energy production from fossil fuels is among the largest sources of environmental degradation in Pakistan today.

Pakistan remains predominantly reliant on fossil fuels as its primary source of energy. Efforts to reduce reliance on fossil fuels through increasing the share of renewable energy in the energy supply systems have met with little success so far. There has been an ongoing sequence of energy sector activities that have tended to focus towards the reduction in the use of fossil fuels. These activities have ranged from the identification of potential renewable resources such as hydropower, wind, solar, and biomass energy, through to the development of a part of hydropower potential and demonstration-scale projects for the rest. However, the efforts to develop and integrate renewable energy technologies (excluding large hydro) into the country's energy mix have been relatively unsuccessful for a variety of reasons. It is vital to identify the barriers and challenges that have been encountered; without which we cannot move towards addressing them.

In this article, an effort has been made to identify the barriers that limit the use of renewable energy technologies in general and with specific reference to Pakistan, and outline the measures to address these barriers.

2. Barriers to renewable energy development

The barriers to development of renewable energy technologies, in general, are described below in detail [1–3]. Some of these may be specific to a technology, while some may be specific to a site, an area or a region.

2.1. Policy and regulatory barriers

- With the power purchase agreement structured at utilities buying power at fixed rates from generators, there may not be sufficient incentives for power generation from renewable sources with fluctuating cost.
- Lack of well-defined policies for private participation and delays in clearances and allotments for private sector projects hinders private participation in renewable energy projects.

2.2. Institutional barriers

- Lack of coordination and cooperation within and between various ministries, agencies, institutes and other stakeholders delays and restricts the progress in renewable energy development and commercialization.
- Absence of a central body for overall coordination of energy sector activities results in duplication of R&D activities.
- The lack of legislations, approved energy policies and regulations leads to situation where subsidies etc. can mean biases and often no effective control of electricity prices.
- Non-incorporation of renewable energy issues in the regulatory policy and lack of awareness among regulators restrict technology penetration.

2.3. Fiscal and financial barriers

- For the development of renewable energy technologies, there are barriers in obtaining competitive forms of finance due to lack of familiarity and awareness of these technologies, high-risk perception, and uncertainties regarding resource assessment.
- There is a lack of financial resources and proper lending facilities, particularly for small-scale projects.
- Investments in renewable energy technologies are not attractive under high-discount rates and short-payback period requirements. Under such conditions, generation options that have relatively lower capital costs, shorter gestation periods, high efficiency and availability are preferred.
- The intermittent generation characteristics of renewable energy technologies and their site-specific nature may place the renewable energy developers in an unfavorable position regarding structuring of contracts for power transmission as compared to non-renewable energy developers. Intermittent generators may be required to pay higher charges per kWh to transmit power. The site-specific nature of the renewables may be a drawback under some transmission pricing schemes where the rates are based on the distance.
- The provision of financial support to renewable energy technologies is restricted to the investment cost of the technology. The lack of financial support for working capital requirements hinders operating and maintenance of the equipments as well as setting up consumer service infrastructure.

2.4. Market-related barriers

- Market requirements and R&D of renewable energy products are not matched. Therefore, product development is poor, and continues to be largely supply-driven rather than being responsive to user needs. This results in limited market penetration of renewable energy technologies.
- Subsidies to conventional fossil fuel energy resources give them an unfair advantage over renewable energy resources.
- Market prices do not reflect environmental costs and damage and mask the striking environmental advantages of the new and cleaner energy options.
- The market reforms leading to setting up of an electricity market with competitive and reliable power supply tariff rationalization and elimination of subsidies and grants may bring down the penetration of renewable energy technologies.
- Restructuring and unbundling under market reforms may reduce incentives for distributed generation.
- For biomass-based technologies, the barriers are unsustainable biomass supply and non-existence of a fuel market, unreliable supply of biomass and frequent price fluctuations.
- Lack of marketing infrastructure with promotion campaigns, after-sales service infrastructure, quality control measures, etc. for most of the renewable energy technologies restrict their penetration.
- Lack of successful and replicable business models hinders renewable energy technology adoption.

2.5. Technological barriers

- The current energy generation cost from renewable energy sources is high, due to high-capital cost and low capacity factor in comparison to conventional power-producing options.
- The term ‘‘transaction costs’’ describes the outlay in time and money to obtain agreements, get approvals, make decisions, arrange financing, and other similar activities required to move a project from idea to reality. Transaction costs are a strong barrier to renewable energy development for two reasons. First, renewable energy projects are typically much smaller than fossil fuel projects. Many transaction costs are essentially ‘‘fixed’’. That is, they are roughly the same for a small project as for a large one. Therefore, transaction cost per unit of energy produced from renewable energy projects is typically much higher than that from fossil plants, creating a competitive disadvantage. Secondly, renewable energy projects typically are more complex in organization and in relationships to the grid than individual fossil fuel plants. They require agreement among more parties, involve either multiple products or are fueled by by-products, and have broader connections with other aspects of community economic, social, and development affairs. Therefore they inherently involve more complex analyses and negotiations.
- Minimum standards in terms of durability, reliability, performance, etc. are lacking for renewable energy products, thereby affecting commercialization of renewable energy technologies.
- There is a general lack of detailed renewable energy resource assessments and data banks.
- High potential of renewable energy supply sources exist in areas with low level of demand due to developmental and socioeconomic patterns. This supply–demand mismatch coupled with the problems in transfer of power from such regions leads to a very large share of the potential remaining unexploited.
- Non-availability of physical infrastructure, and transmission and distribution networks in potential sites of renewable energy supply leads to low exploitation of their potential. This is especially valid for wind, solar thermal and geothermal energy projects.
- Renewable energy sources such as hydropower are very often located in remote, dispersed and inaccessible areas that necessitate high-investment requirements in transmission lines for power supply.
- The scale of operation of wind and solar technologies is constrained by matching supply with load duration curve, leading to very low-plant load factors with a very high percentage of unused capacity. For ensuring reliable power supply, back-up power supply sources need to be set up, which increase the overall costs.
- Low peak coincidence factors for renewable energy technologies, especially for wind and solar, make them unreliable sources for power supply during the peak periods.
- In the case of cogeneration, there are technical barriers in upgrading of existing sugar mills, setting up of cogeneration facilities and supply of grid electricity. Also, seasonal operation of sugar mills leads to intermittent power supply from cogeneration projects and therefore utilities are unwilling to buy power from these units.
- Unstable electricity grids and their low reliability in operation create problems in power off-take from renewables.
- Inadequate servicing and maintenance of equipments along with low reliability in operations lead to very low-customer confidence and hampers technology adoption.
- The adoption of technologies or equipment may be unsuitable for the selected site, or incompatible with existing system components, or substandard in quality.
- In most cases the technology or equipment is imported; hence spare and replacement parts when required may not necessarily be readily available especially in more remote locations.
- Difficulties in estimation of socio-environmental costs for various alternate energy supply sources for full cost pricing of energy restricts renewable energy development.

2.6. Information and social barriers

- Lack of trained personnel for training, demonstration, maintenance and operations along with inadequate awareness and information programs for technology dissemination impedes renewable energy penetration. Information regarding renewable energy projects is not easily available, which deters further investments in renewable energy technologies.
- Community participation and local capacity building are restricted to just a few demonstration projects. This greatly restricts renewable energy development for decentralized applications in remote areas.
- General information and public awareness in relation to new technologies and understanding the practical problems in implementing and maintaining renewable energy projects is limited.
- There is insufficient networking with local organizations for flow of credit with the result that most of the credit flows to the corporate sector whose primary motivation is taking advantage of the financial incentives. This has disabled renewable energy promotion at the local level.
- Development of renewable energy resources is often subject to the availability of land. Access to and across traditional lands has always posed a constraint that invariably requires resolution through extensive negotiations and often results in significant compensation payments.

3. The case of Pakistan

Despite the development of a number of energy policies and plans, the priority accorded to the renewable energy sector in Pakistan has remained low until quite recently. While the acknowledgement of renewable resources as an alternative source of energy has prevailed in most of the policy and plan documents since early 1980s, little substantive action was taken for their meaningful development. Within the various power policies that have attempted to restructure the power sector and promote private power investments between 1994 and 2002, no

special effort was made to attract financing for renewable technologies. The 2002 Power Policy stresses development of renewable energy resources, but does not provide a detailed framework for the implementation of such projects. Overall, the resource planning and acquisition processes have ignored the value of renewable energy resources. Economic and environmental benefits offered by renewable technologies have generally been overlooked in the planning practices [4].

Prior to the decision relating to constitution of the Pakistan Council for Renewable Energy Technology (PCRET) in May 2001, there is no record of any cabinet directives relevant to the renewable energy sector, with the exception of hydroelectricity [4]. In an important step, the Government of Pakistan created the Alternative Energy Development Board (AEDB) in May 2003 to act as the central national body on the subject of renewable energy. The Board has been actively pursuing its objectives since then. It has prepared standard implementation agreement, standard power purchase agreement for wind energy projects and schedule for power purchase agreements. Ministry of Water and Power, working with the help of Board, issued "Guidelines for Determination of Tariff for Wind Power Generation" in early 2006. Finally in December 2006, the Government of Pakistan approved the much-awaited "Policy for Development of Renewable Energy for Power Generation".

The development of effective institutional support is essential for the development of renewable energy projects. The institutional roles of the various organizations involved have often overlapped and varied over time. Clearly defined institutional mandates have been missing. There has been a lack of coordination between policy-makers, regulators and utilities. A review of past institutional practices in the country clearly demonstrates that the institutions responsible for the development and implementation of renewable projects have largely acted independent of each other. The institutional capacity for decentralized and demand side energy planning is largely absent. Institutions such as the Ministry of Petroleum and Natural Resources (MPNR) and Water and Power Development Authority (WAPDA) are primarily concerned with expansion of energy supplies and infrastructure. The capacity of such institutions to give attention to demand side factors is generally very limited, and there are strong biases within the organizations towards centralized approaches. There are serious issues of capacity in the provincial planning and development departments as well for assessment of renewable projects and ensuring their conformity with provincial developmental priorities [4].

The main role of a regulatory authority is to act as a mediator between the government and the service providers on the one hand, and as a guardian of public interest on the other. The presence of a simple and efficient regulatory process can help resolve disputes that arise during the course of negotiations and define investment and operational parameters. Countries with time-consuming, expensive and unpredictable processes are least likely to benefit from the development of new renewable resources. Prior to the establishment of National Electric Power Regulatory Authority (NEPRA), there was little experience of running a regulatory authority in the power sector in Pakistan, and staff with sufficient regulatory experience was not available in the country. AEDB have developed policies and established criteria for the determination of tariffs for purchase of power generated from wind energy, in consultation with NEPRA. Licensing procedures for renewable projects have been simplified to lower the cost of the regulatory process for the developers [4].

Renewable energy sources are not commercially competitive with their fossil fuel alternatives. Hence, government support is necessary in order to accelerate the commercialization of renewable energy. This can be done through provision of adequate fiscal and financial incentives. The 2006 Renewable Energy Policy offers an attractive package of such incentives to private sector developers for power generation from renewable energy resources. It includes, among other fiscal benefits, exemption from payment of income tax, exemption from import duties and taxes for the power generation equipment and protection against foreign currency risks [2,4].

Various potential stakeholders in the development of renewable energy resources in the country, including policy makers, regulators, utilities, renewable developers and suppliers of technology, are handicapped by the lack of information on site-specific demand for energy and the level of exploitable renewable energy resources as well as the cost, potential availability and performance of renewable energy systems and technologies [4].

4. Recommendations

The government, power and gas utilities, and regulators should adopt and properly implement least-cost planning in resource acquisition. Planning and avoided-cost methods should be capable of identifying the real value of available renewable resources. Transmission, distribution, reliability, and other cost savings associated with decentralized power generation through renewable resources should be identified. Electricity from distributed renewable resources can be cost-effective as a result of reduced transmission losses and lesser investment in transmission capacity. Environmental benefits of renewable resources should be considered in resource planning and acquisition processes. If fossil fuel subsidies are removed and environmental damage costs are taken into account, renewable resources are likely to have comparable or even lower costs than fossil fuels. The Energy Wing in the Ministry of Planning and Development and WAPDA should enhance capacities to ensure that the long-term economic and environmental benefits of renewable alternatives are captured in the national planning process, and time-based targets designed for exploitation of available renewable energy potential [3–5].

The specifics of each project differ, but the techniques used to evaluate them can be defined and codified thoroughly. For example, standardized methods can be defined for calculating financial return that provides all parties with guidance on information required and how it will be used. Standardized methods for determining energy output can be created that will eliminate discussion of assumptions and calculation methods.

Further, techniques for estimating local externalities such as pollution reduction, increased local employment, and economic development can be defined and standardized. Standardization will lessen the overall cost as well as the need for elaborate, expensive, and time-consuming negotiations over the amounts involved. Moreover, it will allow fair comparison among projects [2].

Innovative and sustainable financing programs for renewable energy technologies should be instituted. The government should consider setting up a renewable energy development fund, especially for lending to small investors at attractive terms and conditions.

NEPRA should work closely with AEDB to define criteria and limits for tariffs for purchase of power from non-utility generators. Power purchase criteria and mechanisms specifically designed for commercial-scale wind and solar generation projects, accounting of peculiarities typical of these resources, such as variability, will need to be defined and security packages, including relevant IAs and PPAs, developed. NEPRA should develop the expertise to be able to evaluate tariffs for the purchase of power from renewable sources. The institutional capacity of NEPRA should be strengthened by streamlining staffing procedures to ensure that capable and qualified staff can be hired on permanent positions [4].

Ministry of Environment (MoE) should support the development of renewable resources by helping the public and private sectors benefit from financial instruments, such as Global Environment Facility (GEF) and Clean Development Mechanism (CDM). Enabling actions, such as resource mapping, technology transfer, and training should be conducted under environmental technical assistance programs coordinated by MoE with international donors [4].

The PCRET has so far focused mainly on the micro-hydro, solar thermal and biogas applications. PCRET should enhance its capacity to include wind and PV systems in its portfolio, and to coordinate its activities with the provincial governments. Also it should work closely with the NGOs and rural support organizations to ensure that technology packages offered are compatible with the local conditions in which the technologies are to be applied. Product standardization is one of the measures that PCRET can take to promote renewable energy technologies. The commercial success of renewable energy technologies is vitally dependent on adoption and enforcement of appropriate standards and codes. Minimum performance standards in terms of durability, reliability, and thermal performance are also necessary for market penetration [2,4].

There is an urgent need for technical assistance programs designed to increase the planning skills and understanding of renewable energy technologies by utilities, regulators and other institutions involved. Information specific to viable renewable energy technologies needs to be made easily accessible both to increase general awareness and acceptability as well as to aid potential investors and sponsors of such projects. In particular, a suitably designed national solar wind resource mapping program should be implemented and all data should be made available in computer-readable format. Capacity building in technical requirements for establishing commercial solar and wind farms should be given prime importance. Information dissemination on policies, incentives, technologies and operation of renewable power schemes is necessary to increase general awareness, acceptance and interest in the local adoption of these resources in the country [4].

Pakistan lacks an adequate technical infrastructure to achieve the expansion of renewable energy technologies. The indigenous industry should be encouraged as well as technology transfer from abroad. Sufficient skilled and trained workers to construct, operate, and maintain the facilities are not available; therefore special recruitment and training will be required [2].

5. Conclusion

The current policy environment in Pakistan has been favorable to renewable energy technologies. The 2006 Renewable Energy Policy offers an attractive package of fiscal and financial incentives to private sector investors. The setting up of PCRET, AEDB, Private Power and Infrastructure Board (PPIB) and NEPRA are important steps towards having a sound institutional infrastructure. However, there still exist several barriers to renewable energy development in the country. Better coordination among various stakeholders is required. Least-cost planning should be adopted in resource acquisition to ensure proper evaluation of available options. Innovative financing programs for renewable energy technologies should be put in place. Indigenization of renewable energy technologies can reduce the investment costs significantly.

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